

VII SCHOOL ON ENERGY AND MASS TRANSFER, FREE BOUNDARY PROBLEMS, AND APPLICATIONS

Rosario (Argentina), November 28th - December 3rd, 2005

WORKSHOP ON MATHEMATICAL MODELLING OF ENERGY AND MASS TRANSFER PROCESSES, AND APPLICATIONS

Rosario (Argentina), December 5th - 7th, 2005

SECOND ANNOUNCEMENT

Within the frame of activities planned for the Project PAV2003-00120: Applications and Interdisciplinary Integration of Mathematics, Subproject # 5: Mathematics and Physics: "Modeling and Mathematical Analysis of the Heat and Mass Transfer and its Applications", financed by the National Agency of Scientific and Technological Promotion of Argentina (ANPCyT), the VII School on Energy and Mass Transfer, Free Boundary Problems and Applications and the Workshop on Mathematical Modeling of Energy and Mass Transfer Processes and Applications will be made in Rosario, Argentina, from November 28th to December 7th, 2005.

EVENT SITE:

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GOALS

* Physical-chemical treatment and mathematical modeling of energy and mass transfer problems related to diverse applications.

* Theoretical and numerical study of parabolic and elliptical differential equations with constant and temperature variable thermal coefficients, and Volterra integral equations, and also of variational inequalities involved in these processes.

* Entailment and accomplishment of agreements with research groups and/or other Argentine and foreign basic and applied research institutions of international level, in which analogous problems to those proposed in the Project are studied in order to induce a useful scientific interaction.

* Formation of Doctors and young researchers in the energy and mass transfer applied mathematical techniques, of fundamental importance in a great number of practical applications.

RESEARCHERS / STUDENTS / PROFESSIONALS

Researchers and Graduates in Mathematics, Physics (Energy and Mass), Chemistry, Engineering professionals and students (and compatible branches), with basic knowledge on differential equations.

ACTIVITIES:

*** VII School on Energy and Mass Transfer, Free Boundary Problems and Applications (Rosario, November 28th - December 3rd, 2005):**

Mini-courses:

Course 1 (8hs.): **Rodolfo H. Mascheroni – Viviana O Salvadori** (CIDCA (CONICET - UNLP), La Plata).

Modelling and Simulation in Food Technology.

A) General introduction. Objectives of modelling and simulation in food engineering
B) Operations and processes of food industry that can be simulated through analytical models.

- 1) Heating and cooling. Sterilization. Blanching.
- 2) Drying. Salting. Diffusion of preservatives.
- 3) Biochemical reactions with simple kinetics.

C) Operations and processes of food industry that must be simulated with models without analytical solution.

- 1) Freezing and thawing.
- 2) Dehydration and drying with volume contraction.
- 3) Systems with heating/cooling coupled to mass transfer.
- 4) Biochemical reactions with complex kinetics.

Course 2 (6hs.): **Philip Broadbridge** (Australian Mathematical Sciences Institute, University of Melbourne, Australia).

Nonlinear Diffusion Equations: Applications, Models and Solutions.

A) Overview of modeling applications. Heat conduction, solute dispersion, porous media, surface evolution, population dynamics, population genetics, cell chemotaxis, and pricing of bonds and stock options.

B) Symmetry methods for PDE. Classical and non-classical Lie symmetries. Point, contact, Lie-Backlund, and potential symmetries. Classification of integrable nonlinear evolution equations.

C) Solution of nonlinear heat conduction with solidification. Continuous casting of steel.

D) Solutions for unsaturated flow in soil.

E) Some problems in mathematical biology. Population genetics. Tumor cell migration.

F) Unsolved ubiquitous free boundary problems and complications due to degenerate models.

Course 3 (6hs.): **Ricardo Duran** (UBA-CONICET, Buenos Aires).

Numerical Analysis of Parabolic Equations.

Finite element approximation of parabolic equations. Semidiscretization in space. Complete discretization: explicit and implicit methods. Stability and error estimates.

Course 4 (5hs.): **Rubén D. Spies** (IMAL (CONICET-UNL), Santa Fe).

Inverse Problems in Heat Conduction: Regularization Methods.

Characteristics of inverse problems, inverse ill-posed problems, examples. The Moore-Penrose Generalized Inverse and its singular value decomposition, degree of ill-posedness, the Picard Criterion. Operators and regularization methods, mollification methods: the approximate inverse method. Applications to inverse heat conduction problems: the sideways and backwards heat equations. Computing the reconstruction kernel for different mollifiers. Numerical approximations and numerical results.

Course 5 (4hs.): **Arturo De Pablo** (Univ. Carlos III de Madrid, Leganés, España).

The Blow-up Problem for Semi Linear and Quasilinear Parabolic Equations.

A) Blow-up problems for the heat equation with reaction in a bounded domain and in R^n

B) Blow-up appearance, blow-up rate, blow-up set and asymptotic behaviour.

C) Blow-up for quasilinear equations. Non linear boundary conditions.

Course 6 (4hs.): **Juan Carlos Gottifreddi** (INIQUI (CONICET - UNSa), Salta).

Differential Equations: Perturbation Technics and Superposition.

Introduction. Applications. Heat and mass transfer in systems with chemical reactions. Discussion of the non-linearity of the kinetic model problem. Presence of the decontamination of the catalyst. Diffusion and simultaneous swelling.

Course 7 (3hs.): **Domingo A. Tarzia** (Univ. Austral – CONICET, Rosario).

Moving and Free Boundary Problems for the One-Dimensional Heat Equation

A) The heat equation. The maximum principle. The initial boundary-value problem for the quarter plane.

B) Moving boundary problems. Volterra integral equations of the second kind.

C) Free boundary problems. The Stefan (phase-change) and the diffusion-consumption oxygen problems. Lamé-Clapeyron and Neumann explicit solutions, and applications. Existence theorems of the solution. Asymptotic behavior of the free boundary.

Course 8 (3hs.): **Orlando M. Alfano** (INTEC (CONICET-UNL), Santa Fe).

Energy and Mass Transfer in Photo Reactors. Application to Advanced Oxidation Processes for the Reduction of the Environmental Pollution.

A) General methodology for the modelling of photo reactors. Mass balances. Reaction speed. Photons absorption speed. Radiation Specific Intensity. Radiative transfer equation (ETR) in homogeneous and heterogeneous participative media. Boundary conditions. Absorption and radiation dispersion coefficients. A numerical method to solve the ETR.

B) Application to homogeneous system in liquid phase: Solar reactor with parallel plane plates for the degradation of a pollutant in water solution.

Application to a heterogeneous system in liquid phase: Photo-catalytic reactor with suspended layer for the degradation of an organic pollutant in water solution.

Application to a gas phase system: Photo-catalytic reactor for the destruction of an organic pollutant in an air current.

Course 9 (2hs.): **Graciela Lesino** (INENCO, (CONICET – UNSa), Salta).

Simulation and Monitoring of Thermal Performance in Buildings.

Thermal performance of buildings. General considerations. Energy Balances. Multiroom thermal simulation. Simedif. Other simulation programmes including CFD. Validation. Monitoring.

*** Workshop on Mathematical Modelling of Energy and Mass Transfer Processes and Applications (Rosario, December 5th – 7th, 2005):**

LECTURES

1) **Mahdi Boukrouche** (Univ. de Saint Etienne, Saint Etienne, France), "*On a nonisothermal, non-Newtonian lubrication problem with Tresca law. Existence and asymptotics of weak solutions*".

2) **Philip Broadbridge** (Australian Mathematical Sciences Institute, University of Melbourne, Australia), "*Solution of nonlinear boundary value problems for 4th order surface diffusion*".

3) **Alberto Cassano** (INTEC (CONICET-UNL), Santa Fe), "*Modeling and experimental verification of the degradation of trichloroethylene in air streams employing a fixed bed photo catalytic reactor made of glass fiber meshes coated with TiO₂*".

- 4) **Julio Deiber** (INTEC (CONICET - UNL), Santa Fe), *"Modelling Forced and Natural Heat Transfer Convections in Porous Media"*.
- 5) **Manuel Elgueta** (P. Universidad Catolica de Chile), *"Non-local diffusion processes"*
- 6) **Hugo Grossi** (Univ. Nac. de Luján, Luján), *"Assessment of the incident solar global irradiation over the Earth' surface on Argentina: state of the art"*.
- 7) **Pablo Marino** (FUDE/FISI – SIDERCA, Buenos Aires), *"The application of numerical models to the control of steel reheating furnaces"*.
- 8) **Nelson Moraga** (Fac. de Ingeniería, Univ. de Santiago de Chile, Santiago, Chile), *"Mathematical modeling and numerical simulation of energy and mass transfer processes with finite volume method"*.
- 9) **Pedro Morin** (IMAL (CONICET – UNL), Santa Fe), *"Finite element methods for surface evolution and applications"*
- 10) **Rubén Piacentini** (IFIR (CONICET - UNR), Rosario), *"Mathematical modelling and measurements of solar radiations"*.
- 11) **Sergio Preidikman** (Fac. de Ingeniería, UNRC, Río Cuarto), *"Developing Nonlinear Models for Aeroelastic Behavior"*.
- 12) **José Antonio Rabi** (Univ. São Paulo, Brasil), *"Mathematical modelling and numerical simulation of radon-222 exhalation from phosphogypsum-bearing materials and its air-borne concentration"*.
- 13) **Juan Carlos Reginato** (UNRC, Río Cuarto), *"Some aspects on the dynamical modeling of nutrient uptake for root crops"*
- 14) **Amelia Rubiolo**, (INTEC (CONICET – UNL), Santa Fe), *"Multicomponents diffusion on cheese curing and maturation"*.
- 15) **Luis Saravia** (INENCO (CONICET - UNSa, Salta), *"Solar systems development in the Argentinian Northwest"*.
- 16) **Ricardo Simpson** (Univ. Técnica Federico Santa María, Valparaíso, Chile), *"In line Control Strategies for Food Sterilization Processes"*.
- 17) **Luis T. Villa** (INIQUI (CONICET-UNSa), Salta), *"Some Considerations on the Wellposedness Model formulation of a Immersion Frying Process in Hot Oil Applied to Natural Potato"*
- 18) **Noemí Wolanski** (UBA, Buenos Aires), *"A local monotonicity formula for a singular perturbation problem of interest in combustion and applications"*.
- 19) **Noemí Zaritzky** (CIDCA (CONICET – UNLP), La Plata), *"Mathematical modelling of the energy transfer heating and thawing processes by microwaves"*.

PUBLICATIONS

The courses, conferences and abstract of communications will be published in the Acts of the meeting. Those authors that are interested to publish their complete work will have the

chance to be published after evaluation in “*Latin American Applied Research*” or “*MAT - Series A*” journals.

OFFICIAL LANGUAGES

Spanish, English.

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